

Worshipful Company of Actuaries Lecture  
Heriot Watt University  
1 March 2012  
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**Title:** Model or modeller: where's the risk?

**Abstract:** Being an actuary nowadays is all about modelling, and in this lecture I'll discuss how we should go about it. We all know that all models are wrong but some are useful – what does this mean in practice? And what have sheep and elephants got to do with it? Along the way I'll also consider some of the ways in which the actuarial profession is changing now and is likely to change in the future, and what you should do about it.

Thank you for the kind introduction. I'm very glad to be here tonight, as it's given me a great excuse to come up to Edinburgh for the weekend. I lived here for 11 years, and still miss it. Cambridge, where I live now, is similar in many respects – stunning architecture, flourishing high tech industry, bitterly cold easterly winds – but simply can't compete on others. Cambridge doesn't have the haar, which is good, but is dead flat, which is bad. Moving to Cambridge is not a good idea if you are a hill walker!

Modelling, however, is something you can do pretty much anywhere.



As long as you're not working by candlelight.

Except that's not the kind of modelling actuaries do: building a model out of matchsticks is fiddly, and, many people would think, pointless. Whereas the models actuaries build are, of course, always useful and never over-elaborated.

As the profession's website says, actuaries use their mathematical skills to help measure the probability and risk of future events. They are problem solvers and strategic thinkers with a deep understanding of financial systems and use their skills in maths and statistics to create theoretical models of the world around them. They solve real business problems.

And this means that the models they build have to address really important aspects of the world: the aspects that matter, that affect the businesses that actuaries are working for.

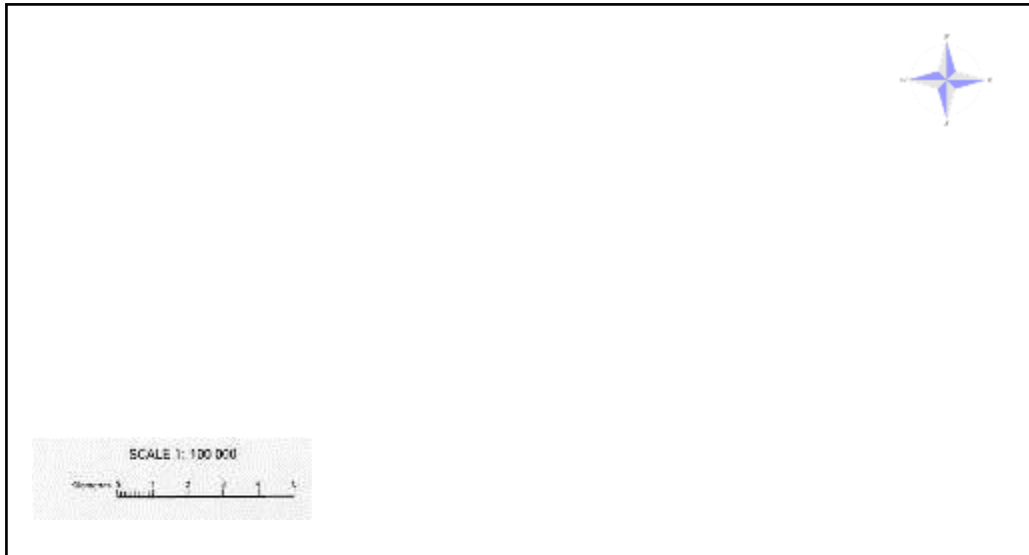
Let's think about this a bit. Models are inevitably simplifications of the real world. They're a bit like maps: a map that is the same size as the real world is effectively useless, unless it covers a very small area. Similarly, the value of a model for the sorts of problems that actuaries look at is that you don't have to wait for things to happen in the real world. You can run a computational model in less than real time, and see what might happen under various circumstances. For example, you can try lots of different scenarios and find out what possible disasters are lurking in them and how likely they are to happen. Or at least you can if your model is close enough to the real world.

This is what George Box meant when he famously said that all models are wrong, but some are useful.

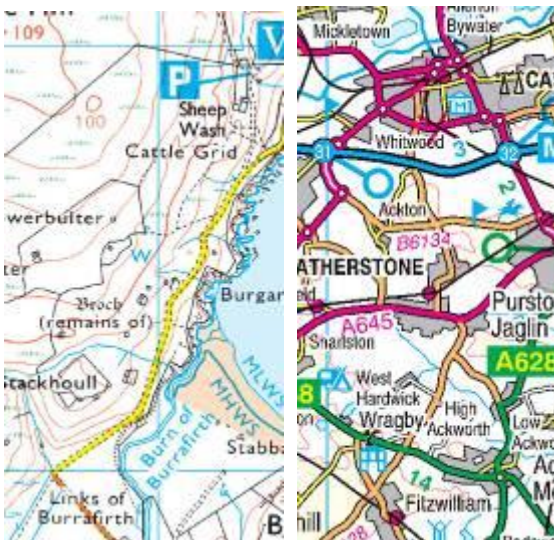


George Box is a statistician (now retired – he's over 90) who originally made his comment in the context of response surface methodology, a statistical technique that explores the relationships between several explanatory variables and one or more response variables. Box and his collaborator used a second order polynomial model to do this, acknowledging that it is only an approximation. They used it because such a model is easy to estimate and apply, even when little is known about the process. Since then "all models are wrong but some are useful" has become pretty much a mantra in the modelling world.

As well as identifying an important overall principle for modelling, Box identified an important trade-off: ease of use against closeness to whatever is being modelled. If an exact model of the real world is the (unattainable) extreme at one end, an incredibly simple model is the rather easily attainable extreme at the other end: in mapping terms, think of a map with all the detail left out – it would be nothing but a blank sheet of paper. You could add [click] a scale, to show how much of the real world it covered, and [click] a compass rose, so that you could orient it properly.



What we want is something between the two. And where we strike the balance depends on what we're trying to do. I wouldn't use a road atlas to guide me when out walking on the hills, or 1:25,000 Ordnance Survey maps to plan a route from Cambridge to Edinburgh.



And, of course, it's not as simple as just choosing the scale – you also have to choose what to leave out and what to put in. Again, the choice depends on the purpose of the map (or model).

Is it mountains and rivers [click] that matter, or political boundaries [click], or simply the shape of the land mass [click]?



That's why it's really important for actuaries to understand the business. It's a phrase you'll hear over and over again – it's a bit like “all models are wrong but some are useful” in that respect. And of course all actuarial models *should* be useful but some will be more useful than others – in my opinion, you need to understand the business in order to build useful models.

You need to understand many aspects of it.

Most important, I'd say, is to understand the point of what you're being asked to do. For a start, you might be able to find a better way of addressing the point. And you'll be able to work out what's important and what's not. Typically, the models that actuaries build are used, directly or indirectly, to help people make decisions – how much money should be put into a pension scheme, what should be charged for insurance, what would be the effect on profitability of taking out a particular type of reinsurance, and so on. The information the models produce should be the information that the people making the decisions will find useful. You may hear people bandying the term “materiality” around as if it's some arcane concept that's really difficult to understand, but all it really means is, will something make a difference?

Something might be immaterial if it's too small to matter – for example, if I'm driving from Cambridge to Edinburgh with the aim of arriving at some non-specific time in the afternoon, it's not material if I spend an extra 30 seconds in the motorway services when I stop for lunch.

Something might also be immaterial if it's irrelevant – my arrival time at Edinburgh can only be very remotely influenced by an accident on the M5 in Gloucestershire.

Which brings us to another aspect of understanding the business. You need to understand the relationships between things – which affects what, and roughly how big the effect is likely to be. Which of the terms and conditions in an insurance contract are likely to affect the claims rate if they change? And which the claim size? What affects the speed with which claims are paid, and how does that feed through to reserving needs?

A good understanding can help you judge whether statistical tools you are thinking of using are likely to be useful. For example, is a distribution you're using in your model intuitively plausible? And by the way, answering "no" to that question needn't mean that you shouldn't use it. It might be mathematically tractable in some useful way, or easy to implement, or simply not have much effect in any case. But it's a question you should think about.

You should also be aware of the limits of your understanding. You need to be able to put things in context. Even if you understand a part of the problem very well, and find it fascinating, it may be wrong to build it into the model, because...

I promised you some sheep.



You probably all know the joke about the actuary and the farmer, standing in some fields of sheep. "You're good at numbers and statistics," says the farmer, "tell me how many sheep I have in these two fields." "That's easy," says the actuary, "it's 1004." "How did you come up with that?" "Well, there are 4 sheep in this field here, and about 1000 in the other one."

Not everything that's easy to calculate is material. You have to know what's important.



So, if you're an actuary looking at capital requirements for an insurance company, you'll probably spend a lot of time modelling all the different types of risk – insurance risk, credit risk, market risk. There's lots of interesting stuff to be done there. A lot of data you can use, from your own organisation and other sources. It's going to be really important to get it all just right,

and there are probably some really cool techniques you can use on those fancy reinsurance treaties.

But when push comes to shove, what is that that makes insurance companies go bust? Interestingly, it's not usually under-reserving, or even charging too little for cover. In other words, it's not insurance risk.

In 2002, a European committee under the chairmanship of Paul Sharma wrote a report on the risks faced by insurance companies and the threats to their solvency. It looked at 21 detailed case studies of insurance company failures, following causal chains back from the immediate cause of failure, which was often an inappropriate risk decision, or an external 'trigger event'. All the causal chains had their roots in internal causes. In the words of the report:

"problems with management or shareholders or other external controllers; these problems included incompetence or operating outside their area of expertise, lack of integrity or conflicting objectives, or weakness in the face of inappropriate group decisions. These underlying internal problems then led to inadequate internal controls and decision-making processes, resulting in inappropriate risk decisions. The firm was now vulnerable to the external 'trigger event' which caused adverse financial outcomes and, in some cases, policyholder harm. The situation got even worse where obstacles prevented the firm from correctly evaluating the financial outcomes and feeding this back to deal with the problem."

This is an excellent description of crystallised operational risks. It's not usually insurance risk that sends insurance companies under: it's operational risk. And that's the elephant in the room.



Operational risk isn't modelled in nearly as much detail as the other risks, even though it's equally, if not more, significant. Why? Because it's incredibly difficult to model. It's pretty easy (for actuaries at least) to come up with a conceptually coherent model of how insurance and related risks work which it's possible to quantify. So that's where the time and effort is spent, because it's possible to feel that you're getting somewhere, the maths is interesting, and, after all, surely insurance is important for insurance companies? And, of course, the mathematics of insurance is where actuaries came into the whole business in the first place.

Which brings us to another important aspect of modelling: communication. Remember the bit about being useful? Models are only useful if the people making the decisions understand and



can use the results. And, mostly, actuaries aren't themselves the decision makers – they develop models to help other people, such as pension fund trustees and insurance company managers.



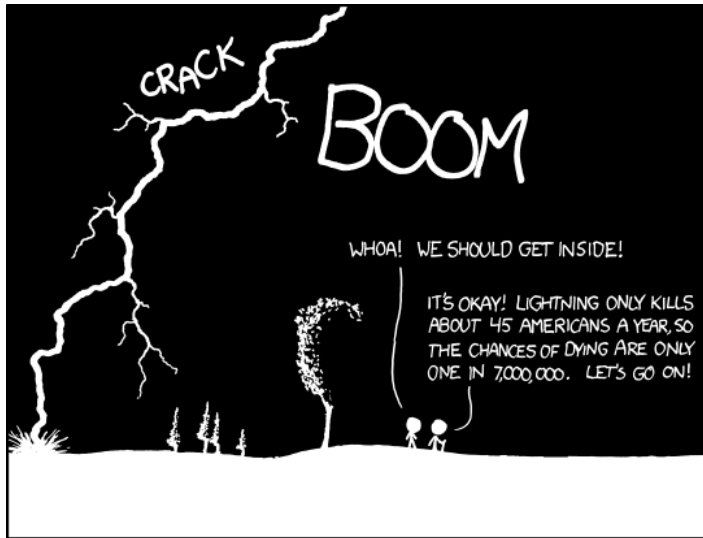
You don't want this sort of reaction when you try to explain your models to people.

Understanding the business means understanding what's important to the people using the model's results. However fascinated you are by the finer points of building the model, they are unlikely to be interesting to most non-actuaries. You just have to accept that, learn what is interesting and important to others, and express what you want to say in terms that they'll understand. A model can't be useful if people don't understand what the results mean and what their significance is.

This is especially important when thinking about the model's limitations. And all models have limitations. So it's vital that the decision makers understand what the limitations are and what their impact is. Some of them are trivial and unimportant – others are likely to severely limit the circumstances in which the model's results should be used. But they also need to understand the good things about the models whose results they are relying on – so that they *can* rely on them. Actuaries (and, indeed any other model builders) have got to be able to explain their models to other people in terms that the other people understand.

Indeed, I would go so far as to say that if you can't explain the model and, especially, its implications, properly to the decision-makers then it's the wrong model to be using. Introducing a sophisticated mathematical technique to improve the model is pointless, in my view, and probably even counter-productive, if it means that the model becomes incomprehensible to others. A simple model that can be easily explained is often a great deal more useful than something complex and sophisticated that baffles people. And, to be honest, there are so many uncertainties in our models anyway that in many cases it's at least arguable whether the extra sophistication improves the results in any meaningful way.

So, I'd just remind you that you have to be very careful with and clear about probabilities and what they refer to. For instance, do you mean one year in every two hundred, or one scenario in every two hundred that might happen over the next year? If you are talking about statistics for a population, and what they mean for individuals, you need to be careful about the conditional probabilities.



THE ANNUAL DEATH RATE AMONG PEOPLE WHO KNOW THAT STATISTIC IS ONE IN SIX.

The lightning can strike!

I've talked quite a lot about the models that actuaries build and use, and some possible risks associated with them. Nearly all of what I've said appears somewhere in the Technical Actuarial Standards, or TASSs, that I helped to develop. I especially recommend the Modelling TAS to you. It's full of good stuff, and some of the associated documents, such as the Significant Considerations and earlier consultation papers and exposure drafts, go into some of the themes I've covered in rather more detail.

The TASSs are still very new: the Board for Actuarial Standards, which developed them, was established in 2006, issued its Scope and Authority in 2008 and its first TAS in 2009. The whole idea of having an independent standard setting body is new to actuaries – the BAS is the only one in the world that is fully independent of its profession. Independent standard setting is just one of the many changes the profession is going through – the merger between the Scottish and English bodies, the Faculty and Institute, is another, as is the increasing professionalisation of the profession's administration.

But I want to talk to you today about another type of change – the change in the membership of the profession. When I qualified as a Fellow, back in the 1980s, there were fewer than 100 women fellows out of a few thousand altogether. By 2010 there were over 2,000 out of around 10,000 – about 20%. So not only has the proportion of women risen, but the overall size of the profession has increased dramatically too. I don't think there are any easily available statistics, but I am pretty sure that the composition of the membership has changed in other ways too – not only is it less male than it used to be but it's more ethnically diverse too, as well as more international. However, you wouldn't necessarily know it by looking at what might be called the establishment in the profession – members of Council, speakers at the big Conventions and at Sessional meetings, and so on.

Here's a picture of members of Council, taken last year.

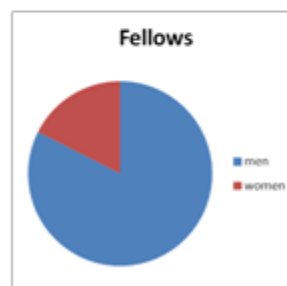
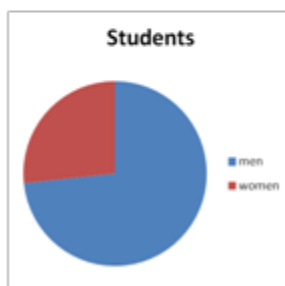
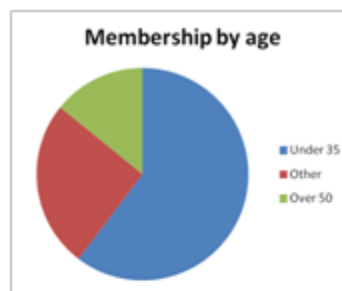




See what I mean? Now, I'm not saying they're not fine people, and good Council members – I know many of them, and they certainly are – but they're not typical of the profession's membership.

We do now have a woman as President, which is good, but it's not that long ago, within my memory anyway, that the Faculty had its first women Council members.

Of course this is partly due to the profession's rapid expansion. Council membership reflects the composition of an older generation of actuaries – predominantly people who qualified 20 or 30 years ago. Nowadays, nearly half the total membership of the profession, or 10,500 out of the total of around 22,000, are students, yet to qualify [click]. And around 13,000, or 60%, are under 35 – in the first 10 to 15 years of their professional lives. Only around 3,000, or under 15%, are over 50, in their third decade of membership or more [click]. About 30% of the total members are women [click], but that rises to 35% of students [click] compared to about 20% of fellows [click].



What this means is that the visible face of the profession is really quite different to the bulk of the membership.

And the visible face isn't confined to the senior members. This is the image that appears on the title slide of every presentation that uses the profession's standard template – in other words most presentations at the big actuarial conventions, sessional meetings and other CPD events.



There's no way I identify with him, and I really don't think it's a good thing for the profession to link itself to a single stereotype like this. The only positive thing is that he's young, whereas mostly the visible face of the profession is much older, whiter, and maler than most of the membership. Which is difficult for the rest of us. We'll all end up older, of course, or at least we hope we will, but the other two are rather out of our control as well. It would be good if the profession's template offered a variety of people to appear on the title slide – some older, some younger, some female, some male, and from a number of different ethnic backgrounds. The profession's membership is diverse, and the public image should reflect that.

And it's not only the visibility aspect that matters – it tends to be the same people who set the direction for the profession, too. They are the ones who get involved as volunteers, respond to consultations, make their views on the future of the profession known. It's a very small proportion who form the vocal minority, and they may not have the same concerns and share the same priorities as other members. It's really important for the future of the profession that those who will be part of that future make sure they have a big say in it. And that means you.

Whenever I go to a Sessional meeting I make a point of making a contribution. Usually because I've got something to say, and am not shy about saying it, but even if I don't think I have a particularly interesting or exciting contribution I'll make it anyway, because that way I'll make sure that at least one woman speaks, and will also lower the average age of the speakers. And I'm too old for that to be a positive comment.

I'd urge you to behave in the same way – if you go to professional meetings of any type, don't hide your light under a bushel but make sure you contribute. And you should go to professional meetings – they are an incredibly valuable part of being a professional. You get to learn interesting things and meet interesting people, but only if you're actually there. You should also get involved in other aspects of the profession, by volunteering and contributing to debates. It's only by getting involved that you can affect how it develops, and its visible face.

But it's difficult. It can feel like a closed club – you might say to yourself “there's no one like me involved, so I won't be welcome” or “I couldn't possibly do anything like that, it's not for people like me.” There are very few role models, very few people to look at and say, “that's what I want to be like.”

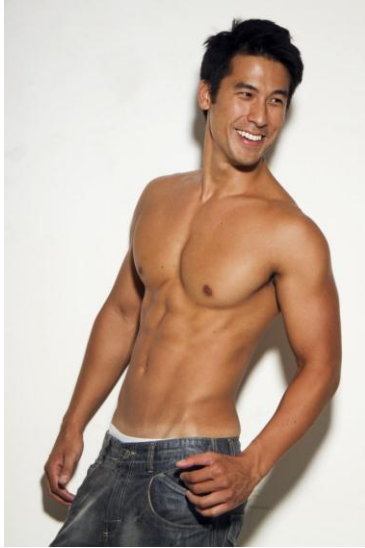
Which brings us nicely back to the modelling theme of this talk. Be positive and creative about role models. Look at people you admire in other arenas, and think which of their qualities you could emulate in the actuarial world. Within the actuarial world, think about what you've got in common with senior figures other than gender or family background. And if you don't see people like yourself out there, don't think that it's impossible, instead get out and be a role model for others.

A word of warning here, though. When I was chatting to a friend about this lecture, and what I might talk about, she pointed out that a lot of role models for women are the air-brushed celebrities or models that you see in X factor and such like. “You know I'm a woman who likes make up and clothes,” she said, “but I'm currently horrified by the height of shoes on sale at the moment – it's foot binding in 2012. I see women hobbling around Canary Wharf in six inch heels – it's ridiculous.”



Believe me, this is not a good look for a professional woman. You want to appear competent and capable, and being unable to walk across a cobbled street just isn't going to do it.

In general, it's fair to say that too much naked flesh is never a good business look.



And it might well put undue pressure on men.

I would recommend that you shouldn't think about emulating the appearance of these celebrities, or even many of their attitudes – wanting tabloid fame is unlikely to make you a success as an actuary. But you might admire their single-mindedness (even if you think it's misapplied), or their persistence in the face of adverse circumstances. Or you might simply decide that they are not suitable role models.

I've talked about two very different types of models – those that we, as actuaries, build and use, and the role models that we, as people, take for ourselves and act as for others. Do they have anything in common, other than the word "model"?

Well, I obviously think they do, or I wouldn't have asked the question! Both types of model can be useful, but neither is perfect – the models we build are always simplifications, and we can never be exactly like our role models – but nor should we want to be. In both cases it's vital to judge what's important – which aspects of the real world should be modelled, which aspects of a role model should be emulated or can be inspiring. And in both cases there are some models that are simply not useful in some circumstances.

Which brings me back to the point. If you take only one thing away from this lecture, remember that All Models Are Wrong But Some Are Useful.



"THAT's your new economic model?"